

CLAIMS

What is claimed is:

1. A method of code programming a ROM device having bit lines oriented in a first direction within a substrate, a gate oxide layer above the substrate, and word lines formed above the gate oxide layer in a second direction, the method comprising the following:

forming a first implantation resistant layer over the word lines and the gate oxide layer;

selectively exposing the first implantation resistant layer to develop first code openings, each first code opening being positioned over a word line and between two adjacent bit lines intersecting the word line at a gate region, wherein the first code openings are formed in a pattern in which substantially all of a predetermined selection of gate regions, which may be coded, of the ROM device openings are exposed;

forming a second implantation resistant layer over the first implantation resistant layer;

selectively exposing the second implantation resistant layer to develop second code openings therein, the second code openings being selected at predetermined locations according to a coding content of the ROM device; and

implanting particles through the second code openings.

2. The method as set forth in Claim 1, wherein the pattern of the first code openings has an area, which is greater than an area encompassed by the second code openings.

3. The method as set forth in Claim 1, wherein the second code openings are formed in a pattern in which less than all of the first code openings are exposed.

4. The method as set forth in Claim 1, wherein the second code openings comprise a first pattern and a second pattern, the first pattern having an area which is substantially greater than an area of the second pattern.

5. The method as set forth in Claim 4, wherein the first pattern encompasses a plurality of first code openings.
6. The method as set forth in Claim 5, wherein the second pattern encompasses a single first code opening.
7. The method as set forth in Claim 1, wherein the first implantation resistant layer comprises an organic polymer.
8. The method as set forth in Claim 1, wherein the first implantation resistant layer comprises an inorganic film.
9. The method as set forth in Claim 7, wherein the organic polymer is a photoresist, and the method further comprises removing the photoresist after the implanting step.
10. The method as set forth in Claim 1, wherein the pattern of first code openings comprises a plurality of discontinuous openings.
11. The method as set forth in Claim 1, wherein the pattern of first code openings comprises merged openings.
12. The method as set forth in Claim 1, wherein the pattern of first code openings comprises a combination of discontinuous openings and merged openings.
13. The method as set forth in Claim 10, wherein the discontinuous openings define holes having a single pitch.
14. The method as set forth in Claim 10, wherein the discontinuous openings define holes having a plurality of pitches.

15. The method as set forth in Claim 7, wherein the first implantation resistant layer comprise a photosensitive material
16. The method as set forth in Claim 15, wherein the first code openings are formed by a one-mask exposure of the first implantation resistant layer.
17. The method as set forth in claim 15, wherein the first code openings are formed by a two-mask exposure of the first implantation resistant layer.
18. The method as set forth in Claim 15, wherein the first code openings are formed by a plurality of exposures using a plurality of masks.
19. The method as set forth in Claim 17, wherein the two-mask exposure comprises two steps of exposing the first implantation resistant layer to generate two exposed patterns, followed by a step of developing both of the two exposed patterns at the same time to thereby pattern the first implantation resistant layer.
20. The method as set forth in Claim 17, wherein the two-mask exposure comprises (a) performing an exposing and developing sequence to generate a first pattern in the first implantation resistant layer, followed by (b) performing another exposing and developing sequence to generate a second pattern in the first implantation resistant layer.
21. The method as set forth in claim 19, wherein one of the exposing steps comprises forming an image on the device by exposing a first mask having a plurality of vertical strip openings and exposing a second mask having a plurality of horizontal strip openings.
22. The method as set forth in Claim 1, wherein the first implantation resistant layer comprises a negative photoresist material.

23. The method as set forth in Claim 7, further comprising treating the first implantation resistant layer using at least one of an ultraviolet light exposure, a treatment implant, a charged particle beam treatment and a treatment plasma, to stabilize the first implantation resistant layer before the second implantation resistant layer is formed.
24. The method as set forth in Claim 1, wherein the first implantation resistant layer and the second photoresist layer are the same material.
25. The method as set forth in Claim 1, wherein the second implantation resistant layer is photoresist.
26. The method as set forth in Claim 1, wherein areas of the first code openings are smaller than areas of the second code openings.
27. The method as set forth in Claim 1, wherein areas of the first code openings are equal to areas of the second code openings.
28. A method of code-programming a ROM device, comprising:
- providing a semi-manufactured ROM device that is configured to be coded;
 - applying a first implantation resistant material over the ROM device;
 - forming a plurality of first code openings in the implantation resistant material to permit particles to be implanted into the ROM device, thereby forming a patterned first implantation resistant material;
 - applying a second implantation resistant material over the patterned first implantation resistant material;
 - selectively forming a plurality of second code openings in the second implantation resistant material at predetermined locations determined by a coding content of the ROM device, wherein the number of second code openings is less than the number of first code openings; and
 - implanting the particles through the second code openings.

29. The method as set forth in Claim 28, wherein areas of the second code openings are greater than areas of the first code openings.

30. The method as set forth in Claim 29, wherein areas of the first code openings are equal to areas of the second code openings.